DOCUMENT RESUME

ED 198 703 FL 012 077

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TITLE Acquiring a Single New Word.
INSTITUTION Stanford Univ., Calif. Dept. of Linguistics.
PUB DATE Aug 78
NOTE 14p.: In its Papers and Reports on Child Language Development, Number 15, p17-29, Aug 1978.

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS *Child Language: Individual Differences: *Language Acquisition: Language Research: Lexicology: Psycholinguistics: *Vocabulary Development: Young Children

ABSTRACT

Twenty children aged 3:0 to 3:10 were studied for behavior related to the acquisition of a single new word ("chromium," which was presented as designating the color olive green). The research was conducted in three cycles: prior to exposure to "chromium," at the time of a single encounter with that word, and about a week after the first encounter. On a sorting task, performance improved markedly from one cycle to the next. A comprehension task revealed that the children varied in their assignment of a particular color as referent for "chromium," with 47% giving a correct assignment at cycle 2 and 63% at cycle 3 (compared with 35% for a control group). A naming task revealed some evidence that experience with "chromium" influenced the child's naming category for olive. Of the children who understood a hyponym task, none changed his/her judgment whether chromium was a color between the second and third cycles. The failure of half the children to learn anything makes conclusions difficult but points to further considerations, including the cause of "fast mappings." (JB)

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Stanford University Dept. of Linguistics

Papers and Reports on Child Language Development, Number 15

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Acquiring a Single New Word

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By the time a child has learned a new word, he or she has gained many distinct kinds of information. To take a hypothetical example, consider the word "wolf" being learned by a child who already has a modest animal vocabulary. She must make a new lexical entry: she must note that "wolf" is an English word. She must learn its syntactic subcategorization, namely that it is a common noun. She must relate it to other English words, to its supernyms (such as "animal") and hyponyms (such as "Siberian wolf") and other words in the same lexical domain. She must also learn what "wolf" refers to. And she must restructure the conceptual domain of animals, at least with respect to how they are named. Suppose, for example, that wolves were previously called "dog." Then learning a new word may be the occasion for learning a new concept, for differentiating dogs from wolves. At the very least, it is the occasion for learning that wolves have a different name from dogs. Clearly, then, learning even a single new word involves learning a great deal of information.

In the past, word learning has been studied in several different ways - there have been vocabulary counts, diary studies, cross-sectional and longitudinal studies of the acquisition of organized lexical domains such as size, color or quantity. But in all of these paradigms, there is no control over the input to the child. It is not known how much exposure he or she has had to any given word, nor in what contexts. Thus, while much can be learned about word learning from these procedures, they are not ideal for achieving an understanding of the process itself. Surprisingly, the obvious technique of teaching children an unknown word has been little used (see Carey, 1978 for a review). None of these was designed to mimic the circumstances in which children naturally encounter new words and none was designed to probe for partial acquisition along the way. The present study is an attempt to fill this gap.

The experimental procedures that we ultimately designed were intended to provide a strong test of the child's word learning skills. For us, that meant several things. First, we wanted to present the new word in a situation that would approximate a child's everyday word-learning experience at its most casual and undirected level. This meant using a situation in which there was not direct teaching - a situation in which the child was not even aware that he or she was supposed to be learning a new word. And second, since we wanted to test the outer limits of the child's word learning skills, we wanted to provide only a single exposure to the word and we did not want to assess a child's learning until after some time had elapsed.

The experiment that we finally designed has now been run in a pilot version with fourteen three- and four-year olds (Carey, 1978) and in a more extended version, to be reported here.

In the pilot study, we introduced a new word, "chromium" which designated the color olive green. The introducing procedures were intended

to convey enough information so that the child could learn that "chromium" named olive, but we also wished to avoid any indication that children were supposed to be learning something new. Since our subjects were in nursery school, we decided to have their teacher introduce the term within the context of a normal classroom activity. Thus, for example, in the course of setting up for snacks, the teacher might take a child aside and say, "You see those two trays over there. Bring me the chromium one. Not the red one, the chromium one." By contrasting "chromium" with "red" the teacher indicated its status as a color word while the situation enabled the child to identify its intended referent. Nevertheless, the child could easily carry out the task without ever attending to the word "chromium" simply by interpreting the contrast "not the red one." In fact, however, some children repeated an approximation to "chromium": and most asked for some confirmation (e.g., "You mean this one?"). These children clearly flagged "new word!" upon hearing a phonological sequence with no current lexical entry. Subsequent tests of acquisition were carried out in a different room by a different experimenter, one week or more later. There were three cycles of introducing events and assessments, taking place over a period of several months.

The results of this pilot study suggested that the process of acquisition can be separated into two phases, distinguished from each other in terms of their time course. The first, dubbed the fast mapping, occurred upon the first encounter with the new word, or at least upon only a few encounters. Included in the fast mapping is only a small fraction of the total information that will constitute a full learning of the word. The second phase, the long, drawn out mapping, extended over the entire period of several encounters with the word. Even after four months, many children had not progressed beyond their initial partial reorganization of their color lexicons. Two different patterns of partial knowledge emerged: in one, the child focused on the word "chromium" and seemed to treat it as a synonym of "green" or "brown." In the other, the child focused on the color olive, and seemed to be sure that it had its own name, but could not remember what that name was.

The purpose of the present study is both to replicate and extend that original pilot work. There are several reasons why the results of the pilot must be considered only tentative.

First, the subjects were part of Bartlett's (1978) longitudinal study of color terms and had therefore participated in a number of color assessments. Conceivably, the pilot results could have been due to some resulting increased awareness of color. To control for this in the present study, we used naive subjects and we disguised our interest in color by including a number of non-color activities each time the experimenter worked with a child.

A second problem has to do with the limited nature of our pilot assessment procedures. Although we were interested in obtaining information about partial mappings, we actually used only two tasks: a comprehension task in which children were asked to identify a "chromium" color and a production task in which children were asked to name olive. Bartlett's longitudinal work, however, indicates one of the earliest things that children know about color words is that they are hyponyms of the supernym "color" - a learning which seems to be achieved even before children acquire stable referents for their terms (Bartlett, 1977). We therefore felt it necessary to add some sort of hyponym assessment to our study. In addition, we also thought it advisable to add a sorting task to assess the effects of children's encounter with "chromium" on their perception of the color olive.

A third problem had to do with the lack of certain controls in the comprehension task that we used. When we asked children to choose the "chromium" color, the stimuli from which they could choose included seven focal colors (including green) and olive. Thus, children could (and did) choose olive simply because it was the only non-focal color in the array and the only one for which they did not already have a name. To control for this, we added a second non-focal color, maroon and two related focals, red and purple.

Finally, since most of the children in our pilot sample had extensive color lexicons, we were unable to investigate the relation between the extent of a child's prior lexical knowledge and the child's learning of "chromium." It seemed reasonable to suppose that having a larger color lexicon would facilitate such learning and to test this, we selected our sample so that half of the subjects had color lexicons of 4 or fewer words and half, large lexicons of at leat 9 words.

In sum, then, our purpose in this research is to study the process of learning a single word. By introducing the word in a casual and incidental way and by delaying assessment for a week, we seek to confirm the reality of the "fast mapping" observed in our pilot study. By including several different assessment procedures, we seek to arrive at a better characterization of the extended mapping by which children arrive at full acquisition. And by including in our sample two different levels of knowledge about color words, we seek to test the hypothesis that extensive knowledge of the domain will facilitate learning the new word.

METHODS

Plan of the Research. The research was carried out in three phases: (1) at baseline, prior to any exposure to the word "chromium", children's color lexicons were assessed, along with their naming of the color olive and their ability to differentiate olive from other colors on a matching task; (2) the word "chromium" was encountered once; and (3) learning about "chromium" and the naming of olive was subsequently assessed. Seven to ten days elapsed between the time of a child's baseline assessment and her single encounter with "chromium"; another seven to ten days elapsed between that experience and the learning assessment. This constituted the first cycle of the experiment and was intended to assess development of a possible "fast map." Ten weeks later, children were exposed to "chromium" once again: this time there were two encounters, occurring two days apart; and after a seven to ten day interval, the learning assessment was once again administered. The purpose of this second cycle was to assess learning after more extended exposure to the word.

PROCEDURES

The baseline assessment was administered in four sessions and the "chromium" learning assessment in two. Each session lasted about seven minutes and included six short non-color distractor tasks as well as the color assessments. The same research assistant administered all assessment tasks to a given child. All children attended nursery school and participated at their school.

Introduction to "chromium". Introduction procedures were identical to those used in our pilot study. In each case, the introducing event occurred in a private conversation between the child and his or her classroom teacher. Children in the experimental group were scattered in four different classrooms, so that four different teachers introduced the word.

Baseline vocabulary assessments. These were similar to those described in Bartlett (1978, 1977). Comprehension and production tasks were used to evaluate children's color vocabularies. In the production task, the experimenter displayed pieces of colored paper, one at a time, and asked: "What color is this?" There were 11 colors matching as closely as possible the focal colors for the eleven basic color terms of English. The same eleven papers were used on the comprehension task, arranged in groups of five or six; the experimenter said, "Show me the red one or the green one or whatever." Children were given credit for knowing a particular color word if they answered both the production and comprehension questions about it correctly.

Olive sorting task. This assessed children's ability to differentiate olive from colors that were thought to be confusable. The stimuli consisted of six colored boxes and strips of matching colored paper. The strips were displayed, one at a time; the experimenter asked the child to put each strip "in the box that's the same color." The colors included olive, focal green, brown and gray. In addition, maroon and its potentially confusable color, red, were added to accustom children to seeing displays that included several non-focal and related focal colors, in order to control for any tendency to categorize olive as the only odd-looking color in the bunch.

Olive naming task. This assessed children's naming of olive both before and after exposure to "chromium." At baseline, we simply included olive among the colors to be named on the regular production task. At later assessments, children were asked to name a few colors, one of which was olive.

Chromium comprehension task. This assessed whether children learned a referent for "chromium." This experimenter displayed an array of nine colors and asked subjects to identify the following three: blue, chromium and yellow - in that order. If the child failed to choose olive for "chromium," then the experimenter went on to name the color that had been chosen - for example, if the child pointed to brown as the "chromium" one, then as a final question, the experimenter asked the child to point to the "brown" one. The colors in the array included focal green, brown, gray, blue, yellow, red, maroon, purple and olive.

"Chromium" hyponym task. This assessed whether children had learned that "chromium" named a color, regardless of whether they had learned that it designated a particular hue. Children were asked to name some colors; they were then asked if "purple" was a color, "cold" was a color, etc. Included in the list were "chromium" and a nonsense word, "tearval." To obtain credit for understanding the task and for knowing "chromium" is a color word, the child had to produce the pattern of responses indicated in Table 1.

Table 1 Hyponym Assessment Task

	Question	correct response
1.	Do you know the names of any colors? What colors do you know?	child names colors
2.	Is purple a color?	yes
3.	Is cold a color?	no
4.	Is noisy a color?	no
5.	Is chromium a color?	yes
6.	Is pink a color?	yes
7.	Is silly a color?	no
8.	Is tearval a color?	no

Subjects

The experimental sample initially consisted of ten pairs of subjects, matched for age and sex, one subject having a vocabulary of 9 or more color terms ("good namers") and one having 4 or fewer ("poor namers"). One poor namer was dropped from the sample, however, due to frequent absence, bringing the total of experimental subjects to 19. All were between the ages of 3;0 and 3;10 when we started; $\bar{X}$ age = 3;6.

To evaluate the effects of exposure to the various assessment procedures independent of exposure to "chromium," four control groups also participated. A sorting control group consisted of 7 good and 5 poor namers ($\bar{X}$ age = 3;2). Each participated in sorting tasks on two occasions, one week apart. There were two olive naming control groups. Children in one group named olive on two occasions, one week apart (8 good namers; 3 poor namers; $\bar{X}$ age = 3;4); children in the other named olive on two occasions, six weeks apart (7 good namers; 2 poor namers; $\bar{X}$ age = 3;3). A comprehension control group consisting of 10 good and 10 poor namers ($\bar{X}$ age = 3;2) received the comprehension task so that we could find out how children would respond to a request to "find the chromium one" without having been exposed to our introducing event.

Results

Results will be analyzed in three stages. First, we will look for evidence of learning, and particularly for evidence of a "fast map", in the experimental group by comparing responses of these subjects with control subjects on the sorting, comprehension and olive naming tasks; and by examining the pattern of responses obtained from the experimental subjects on the hyponym task. Next, we will examine the pattern of responses from individual subjects in order to characterize the various routes to learning. Finally, we will compare the pattern of responses obtained from children with large and small lexicons to determine the effect of vocabulary size on children's learnning.

Sorting task: experimental and control subjects. Data from all three sorting tasks (baseline, first assessment battery, and second assessment battery) are available for 18 of the experimental subjects (Table 2). Errors were made by most (78%) of the children during the pretest. Most commonly these errors included olive. That is, either olive was placed into the green, brown, or grey mailbox, or vice-versa. Other patterns of errors involved missorting maroon, missorting red, or failing the sorting task altogether (chaotic sorting).

Table 2

SORTING

		Baseline	Cycle 1	Cycle 2
	No errors	4	15	17
errors	olive only	6	2	1
	olive & other	4	1	0
	only other	3	0	0
	chaotic	1	0	0

As can be seen from Table 2, overall performance improved markedly between the pretest (78% of the children with errors) and the first assessment battery (17% with errors.) By the second battery, only 6% of the children still made sorting errors. If individual children are analyzed, the pattern of progress is upheld. Children never became worse on the sorting task. They either stayed the same or progressed.

It is clear from Table 2 that improvement was not limited to improvement in sorting olive. Some general improvement, due perhaps to practice on the sorting task, or practice naming colors, occurred across all of the sorting errors.

As Table 3 shows, the control group made almost as many errors sorting olive at cycle one as they did at baseline. Further, while all children in the experimental group either remained stable or progressed, two children in the control group who had made no errors at baseline made errors involving olive at cycle one. These results suggest that the experimental group's improvement in sorting olive was due, in part, to the chromium introducing event. However, the results are equivocal, since the control group made many fewer errors sorting olive at baseline. Further control subjects will be run, in an attempt to equalize the groups in their initial error rates.

Table 3

% MAKING ERRORS INVOLVING OLIVE

	Baseline	Cycle one	Improvement
Experimental	56	17	$p < .02$
Control	33	25	n.s.

Comprehension task: experimental and control groups

The comprehension task was intended to tell us whether the child has assigned some particular color as referent for "chromium." What possible referents could the child adopt? First, the child could have mapped "chromium" onto the color olive; in that case, she should pick olive when asked to indicate the "chromium" one; 8 experimental subjects did this at cycle one and 10 at cycle two. A child could also have developed the hypothesis that "chromium" is another word for the color-naming category into which olive had been placed at baseline. Thus, for example, if olive was named "green" then "chromium" might be learned as a synonym of "green." In that case, a child should pick olive or focal green for "chromium" and olive or focal green for "green" as well, as one experimental child did at cycle two. Finally, it is possible that the child might have assigned the color olive as a referent for "chromium" but might have difficulty distinguishing olive from focal green, brown or gray. This is especially likely, given the pattern of errors observed

on the sorting task. Choosing brown, gray or focal green for "chromium" would be consistent with this pattern, but since children might do this even if they were only guessing, we can adopt a more stringent criterion, and give a child credit for having a referent, if the child picked one of these colors for "chromium" and at the same time, picked olive as referent for that color. (For example, if the child picks brown for "chromium" the child must also pick olive for "brown.") This was done by one experimental subject at cycle one and at cycle two.

Considering the control data, we find that 30% of these subjects picked olive when asked to identify a "chromium" one, presumably by guessing since they had certainly had no previous exposure to the word. This suggests that olive was in some way still a salient or "odd" color, despite our attempts to control for this by including maroon, red and purple in the array, a finding which indicates that some of the olive responses of our experimental group could have resulted from guessing as well. Nonetheless, by cycle two, the two groups do differ in their response to the comprehension task, a difference which indicates that some learning has taken place (Table 4).

Table 4
"CHROMIUM" COMPREHENSION RESPONSES

Response Type	Experimental Group N=19 Cycle One	Experimental Group N=19 Cycle Two	Controls N=20
Olive	8	10	6
Synonym	0	1	0
Perceptual confusion	1	1	1
Percentage correct	47%	63%	35%
Different from controls	N.S.	$P < .08$	——

Olive naming task: experimental and control groups

Taking all the baseline production data together (experimental sample plus control groups) several solutions to the problem of naming olive emerged. Most children (64%) assimilated olive to a stably named category, most often "green" or "brown". A sizable number of children (15%) assimilated olive to an unstably named category of achromatics. As described by Bartlett (1977), many children in this age range have not fully acquired the terms "white," "grey," "black" and "brown." Some of the children in the present samples named olive with one of these terms, a term he or she did not use fully correctly on the rest of the production test. A small number of children (8%) said they didn't know what to call olive, or called it "dark green" or "army green." Finally, the remaining children, (12%) among the poor namers, called olive by the name of an unrelated color such as "red." The experimental and control groups did not differ in their baseline naming of olive.

In our pilot study we noted that many children changed what they called olive between their baseline naming and the first assessment battery. We interpreted this as indicating that they had learned, as a result of the introducing event, that the color olive takes some name other than "green." Evidence for this was a class of responses never seen on baseline productions: actual approximations to "chromium", e.g., "crum," or locutions like "that's a hard one," or "I forgot." Such

responses were seen in the present experimental series as well, by 2 of the 19 children at cycle one and by 5 of the 19 children by cycle two. These children clearly had learned that olive takes a different name from "green."

However, the sorting errors and the assimilation to an unstable naming category pattern make changes from baseline other than the above two types ambiguous. Since sorting errors indicate olive is confused with green, brown, or grey, changing the naming from "green" to "brown" or "grey" may reflect simple perceptual confusability. Similarly, if olive is assimilated to an unstable achromatic naming category, changing from "grey" to "brown" or "black" may reflect the temporary realignment of this category.

To see whether the sheer number of changes reflects the introducing event, two control groups were run in which the baseline naming task was followed by another production task either 1 week or 6 weeks later. The control groups did not differ from each other , so are merged (see Table 5). Since random namers would be expected to change, they are excluded from the analysis. At t_1, there is clearly no difference between the experimental group and the control group. At t_2, the experimental group does differ from the controls ($p < .03$, Fisher exact test.)

Table 5
OLIVE NAMING

	Control (N=18)	Experimental (N=15)	
		T_1	T_2
% changing	27	33	67
Different from control	-	N.S.	$P < .03$

In conclusion, two types of evidence demonstrate that the experience with "chromium" influences the child's naming category for olive. Most directly, one child changed his name for olive to "crum"(cycle one) and another to "chromium" (cycle two). Other children adopted locutions, such as "that's a hard one " never shown in control data. This is taken as indicating that the child knows olive has its own name, but can't remember "chromium." Less directly, by cycle two, significantly more experiental children changed what they called olive from baseline production than did a control group. This too is taken as reflecting knowledge that olive should not be categorized with green, but uncertainty as to how it should be named.

Hyponym task: experimental group

Many children could not do the hyponym task. Some said every word was a color; others said no word was a color; still others appeared to answer randomly. A child was credited with understanding the task if he or she made no more than one error on all judgments excluding "tearval" and "chromium." On these items two patterns emerged. Either the child denied both "chromium" and "tearval" were colors, or he or she said "chromium" was a color and "tearval" was not. A child was credited with knowing that "chromium" was a hyponym of color if he or she understood the task and gave the latter pattern on "chromium" and "tearval."

At the first assessment, eight children understood the task, four of whom judged "chromium" a color. At the second assessment, twelve children

could do the task, six of whom judged "chromium" a color. No child who understood the task at the first assessment failed to do so at the second and, no child who judged "chromium" to be a color at cycle one failed to do so again at cycle two.

Summary: group data

By the end of cycle two, the experimental group differed from the control groups on the comprehension and olive naming tasks. In addition, results of the hyponym task suggest that some experimental children also acquired knowledge that "chromium" was a color.

By the end of cycle two, the experimental group had had three brief introducing exposures to "chromium"— one at cycle one and two at cycle two, ten weeks later. In addition, we must remember that children had also heard the word "chromium" twice at the cycle one assessment— once on the hyponym task when the experimenter said, "Is chromium the name of a color?" and later in the same session, on the comprehension task when the experimenter said "show me the chromium one." (These tasks were always administered after the production task.) That is, five exposures to "chromium"—three of which occurred ten weeks prior to the cycle two assessment--have influenced the child's naming of olive and have effected a lexical entry for "chromium" which, in some cases, apparently includes the knowledge that it is a color word and in some cases, includes knowledge of its referent.

These cycle two results indicate that rapid learning of lexical information seems to occur, but if we are to make a really stringent test of the "fast map" hypothesis then we must consider only the results of the single exposure to "chromium" at cycle one. Although evidence for each of these pieces of lexical knowledge is more scanty, we might note that even at the cycle one assessment, one child did name olive "crum" and half of the children who understood the hyponym task judged that "chromium" was a color while "tearval" was not. This suggests that some learning seems to occur after even a single exposure and that this learning is evident on an assessment task administered one week later. Even on this most stringent test, then, the evidence supports the notion of a "fast map."

But while these data do provide evidence for the "fast map", they give a very incomplete picture of the patterns of acquisition which actually occurred. For one thing, they tell us nothing of the relations among the various assessment tasks. Are children similar to each other in their patterns of partial acquisition? Are learnings of individual children stable and cumulative across the ten week period? To address these questions it is necessary to analyze the pattern of responses from individual children.

Individual Patterns

Table 6 lists the individual patterns for all 19 children. Acquisition ranged from total (child #19) to none (children # 1 - 8). In the middle were many distinct patterns of partial acquisition.

Two children (#9 & 10) would have been classified in our pilot study as "odd color/odd name" children. They always picked olive for "chromium", and they changed their name for olive from "green" to "gray". Since "gray" did not have a stable referent in their lexicons, such a change could reflect the realization that olive takes its own name. These

Table 6
Individual Patterns

Subject #s	
1-8	No Learning (n=8). Never changed baseline name for olive. If could do hyponym task, denied "chromium" was a color word. Did not choose olive for "chromium" on both comprehension tasks.
9, 10	Possibly No Learning (n=2). Could do hyponym, denied "chromium" a color word. Differed from the above group in two ways: picked olive for "chromium" on both comprehension tasks and changed name for olive to "grey" at cycle two, from "green" at baseline and cycle one. For both children, "grey" an unstable label.
11,12	Olive Has Its Own Name, Status of Chromium" Unclear (n=2). On cycle two production one child said "that's a hard one," the other, "I forgot." Both children possibly include "chromium" among unstable achromatics. One (#11) calls olive "grey" at baseline, "black" and cycle one, making many errors on other achromatics. At cycle one comprehension, she chooses brown for "chromium", and cycle two, olive. The other child (#12) shows a similar pattern of production, and chooses brown at both comprehension tasks. Both were unable to do the hyponym task.
13-15	"Chromium" a Color Word, Possible Referent. Naming Category Of Olive Unchanged (n=3). These children all said "chromium" was a color word, two at cycles one and two, one only at cycle two. They never changed their baseline name for olive. Two (#13 and 14) picked olive for "chromium" on both comprehension tasks, one (#15) only at cycle two comprehension.
16,17	"Chromium" a Synonym of "Green" (n=2). For both children this pattern was clear only by cycle two. One (#16), at cycle one passed only the hyponym task. At cycle two production she called olive and focal green "green." In comprehension, she chose focal green for "chromium" and olive for "green." In response to "Is chromium a color?" on the hyponym task, she said, "I know, green." The other child (#17) at cycle one seemed to have it all. Olive was called "crum," olive was picked for "chromium" on the comprehension task, and "chromium" was judged a color word. At cycle two production, olive was called "green" and olive green was chosen for both "chromium" and "green" on comprehension.
18,19	A Referent For "Chromium" and Olive Takes Its Own Name (n=2). One child (#18) picked olive for "chromium" at cycle one comprehension, but otherwise gave no indication of having learned anything. By cycle two, "chromium" was judged a color word. "chromium" was olive green on comprehension, and the child's response to the request to name olive was "I forgot." The other child (#19) by cycle 2 got it all. He produced "chromium", and similarly was correct on the hyponym and comprehension tasks. At cycle one he had begun both parts of the process. Olive's name had been changed to "greenish," "chromium" was judged a color word, but the comprehension task was failed.

children understood the hyponym task and denied "chromium" was a color word, suggesting that if they had learned anything at all, it was to focus on the color olive. Two other children (# 11 & 12) clearly focused on the color olive, saying they forgot its name. If they learned anything at all about "chromium", they included it among their unstable achromatics.

While the above four children focused on the color olive, children # 13, 14 and 15 focused on the word "chromium", never changing their baseline name for olive. Also, the "false synonym" pattern was seen again (children # 16 & 17). These children too did not change their naming category for olive—olive and focal green were both members of a category that could be called "green" or "chromium".

As can be seen from Table 7, the patterns of responses were variable and ambiguous. Learning was highly idiosyncratic. The early acquisitions were of two types—partial or actually incorrect. Partial acquisitions included learning "chromium" was a color word without assigning it a referent (# 15 & 16, both at first assessment). Other children learned olive takes its own name, but could not produce "chromium". Still others combined one or two beginnings with correct comprehension. Actually incorrect were the "false synonym" pattern ("chromium" is a synonym of "green"), and, possibly, the inclusion of "chromium" among the achromatics.

Almost all of the children who learned showed progress between the first and second assessments. The possible exception is #17, who got everything right at the first assessment and who showed the "false synonym" pattern at the second.

Size of the color vocabulary and learning

The relation between vocabulary size and learning is examined by comparing the patterns observed in our good and poor namers. These data are quickly summarized: there appeared to be no effect of vocabulary size on learning. Of the eight non-learners, four were good namers and four were poor. Similarly, there were four poor namers among the learners and five good namers.

We might note that the sample of poor namers actually consisted of two groups: four subjects were minimal namers who could name no more than one color correctly at the baseline assessment and five were more advanced, naming three or four. It might be expected that the minimal namers would be among the non-learners, but this in fact was not the case: two learned that "chromium" was the name of a color and both also chose olive on the "chromium" comprehension tasks. After the experiment was over, we administered another lexical assessment to see if children's color lexicons had changed over the ten-week period and as we might expect, these two minimal namers were among the children whose lexicons had increased somewhat (although both were still poor namers). By contrast, the lexicons of the other two minimal namers stayed the same, a fact which is consistent with their being non-learners on our task and which lends some validity to our claim that the learning observed in our experiment is related to word learning under other, more natural, circumstances.

When we consider the effects of age as well as vocabulary size, the same pattern occurs: the double advantage of having a large color vocabulary and an age above the median made a child no more likely to learn than the double disadvantage of having both a small color vocabulary and an age below the median.

SUMMARY AND CONCLUSIONS

At one level, three results are demonstrational: they show that half of the children picked up something about the word "chromium" or the naming of olive from a single experience with the word. They managed to display that knowledge at an assessment one week later, in a context totally different from the one in which the introducing event had occurred.

That almost half of the children learned nothing indicates that these presentation and assessment conditions might be close to the limit of a three-year-old's ability to achieve a fast mapping for a new color word. Nonetheless, the first demonstrational results confirms the existence of a fast mapping, at least under these conditions.

The second demonstrational result is the fact that progress was made between the cycle one and cycle two assessments. This was shown both in the group results (Tables 3, 4, and 5) and in the pattern of individual responses. This progress, of course, must result from the two additional introducing events at cycle two as well as whatever the child has retained from his or her cycle one experiences. There was a two-month interval between the two cycles, suggesting that if the child's progress is related to the initial fast mapping, then whatever was learned during the fast mapping was permanent enought to be built upon some two months later.

Carey (1978) has called the process of building upon the fast mapping the "extended mapping" and another demonstrational result concerns the nature of this extended mapping. Under the conditions of our experiment, only one child fully mapped "chromium" onto olive green. The rest of the learners exhibited a variety of partial mappings, differing in their strategies for assigning olive a new name or the word "chromium" a referent, showing the extended mappings to be quite idiosyncratic.

One result that surprised us was that children with large color lexicons did not differ from children with small color lexicons in learning "chromium." This result is put into relief by results in a recent dissertation by Rice (1978). She identified 11 children in the age range of the present sample who knew no color words. She taught them to produce "red" in response to "what color is this?" when she pointed to one of ten red objects. The average number of trials needed was 85. She similarly taught them "green" with average number of trials 52. She then taught them a red/green discrimination. After 1000 trials extended over several weeks, four of the children never learned. The rest required an average of 430 trials. Thus, while the present results show that knowing one or two color words is as good as knowing nine or more as far as achieving a fast mapping for a new color word, Rice's results show that knowing at least one is required.

No general conclusions can be drawn from these demonstrations. Rather, a series of questions can be raised. For one thing, we would want to know under what circumstances fast mappings occur, both in terms of differences among subjects and in terms of differences among introducing events. We would also want to know whether fast mappings occur in other lexical domains, and whether the early stages in acquiring a new word are always so idiosyncratic.

At another level of analysis, the results bear on particular hypotheses about the acquisition of the color lexicon. For example, Bartlett's (1978) longitudinal study suggested that the acquisition of the color lexicon by an individual child does not necessarily reflect the evolution of color terms within a particular language. Although it has been suggested that the first color terms to evolve in a language are black, white, red, green, yellow, and blue, Bartlett's developmental research indicates that the

individual child does not necessarily acquire his or her color lexicon in that order. Results of this study support that conclusion, inasmuch as the poor namers did not differ from the good namers. A word whose referent (olive green) would be among the last to evolve as a referent for a basic color terms in a language can nonetheless be among the first learned by a child, provided he has some mininal exposure to it.

Bartlett also showed that the most salient hypotheses about the meanings of color words concern hue (rather than saturation or brightness.) Further, she showed that some young color namers have a category of achromatic colors whose names they have not differentiated. The hypotheses children entertained as to the meaning of "chromium" in this study supported both generalizations. Some treated it as a synonym of "green," others correctly assigned it olive green as a referent, and still others seemed to assimilate it to their class of unstable achromatics.

Several findings from Bartlett's (1977) longitudinal work would yield the predictions that a child would know that "chromium" is a color word before the child assigned it a referent. For example, Bartlett found that for at least some children, there is an early stage in the acquisition of the color lexicon when the child knows that some words are hyponyms of the word "color" but has not yet mapped these onto any particular hue (see also Cruse, 1977; Istomina, 1963). Bartlett also found that for children who know some color words, there are often a few words that are known to be color words that have not yet been mapped onto a particular hue.

Strongest support for the prediction would come (1) if all learners who understood the hyponym task asserted that "chromium" was a color while "tearval" was not; and (2) if this assertion was also among the first learnings among those who understood the task. The data, however, do not support the prediction. Although four of the subjects who understood the hyponym task at time one did assert that "chromium" was a color and "tearval" was not, and for three this was the only evidence of learning, three subjects denied that both were colors while at the same time choosing olive for "chromium" on the comprehension task. Two subjects continued to show this pattern at cycle two. As we have already noted, the fact that 30% of the control subjects also chose olive on the comprehension task may indicate that these experimental subjects were simply guessing, but we cannot discount that they may indeed have learned that "chromium" names olive without learning that "chromium" is to be organized as a hyponym of the word "color." Clearly, the matter can only be clarified by introducing more stringent controls into our comprehension task.

In sum, studying the process of acquiring a single new word yields insights into lexical acquisition in general. This technique can also be used to explore specific hypotheses about acquisition in any particular lexical domain.

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